Chapter 3

Microbes as Indicators of Water Quality and Bioremediation of Polluted Waters:
 A Novel Approach

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ABSTRACT

Water is the most important commodity in the world. Over the large parts of world, humans have inade-quate access to potable water. Since the inception of industrial revolution different toxic compounds have entered in the water bodies due to leakage, improper disposal or accidents and caused great harms to rivers and various water bodies and imposed major health risks on human beings. Water pollution is measured by variety of physical, biological and chemical methods. Microbiological tests have proven to be indispensable part of environmental contamination detection. The main suggested criteria for selecting a microbial indicator for water potability should be: it should be suitable for the analysis of all types of water, present wherever enteric pathogens are present, survive longer than enteric pathogens, must have easy procedure for detection, should be harmless to humans and the level of indicator bacteria in contaminated water should have direct relationship to the degree of pollution.

INTRODUCTION

Water is the foundation of life. It circulates through the land just as it does through the human body, transporting, dissolving, replenishing nutrients and organic matter, while carrying away waste material. With two third of the earth’s surface covered by water and the human body consisting of 75 percent of it, this is evidently clear that it is one of the prime elements responsible for life on earth. Our brain and blood are made of 95% and 82% water, respectively. An average adult body contains 42 litres of water and just a small loss of 2.7 litres can trigger signs of dehydration. To fulfill our basic requirement, we need safe, uncontaminated and clean water. Access to adequate potable drinking water supply is not only a basic need but is also a human right. Of all the problems we face today, those related to water are perhaps the most far reaching in their long-term consequences and the most difficult to tackle. If

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a state is unable to provide basic supply of safe and clean drinking water, sanitation and good hygiene services to its people, then the human right to water has been violated. Drinking water can be sourced from surface water or from ground water. Surface water includes rivers, lakes, ponds, streams and reservoirs. Ground water resources are wells, tube wells, springs, borewells, handpumps etc. Installation of communal facilities such as boreholes, standpipes or wells to provide water of better quality may not improve the situation because these facilities are usually located at some distance from the home and are prone for contamination during collection, transport and storage.

Drinking water as defined by Guidelines for Drinking is “water whose quality doesn’t represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages. It is estimated that poor water sanitation and lack of safe drinking water take a greater human toll than war, terrorism and weapons of mass destruction combined. In 2011, around 768 million people relied on unsatisfactory water supply having high levels of pathogen contamination.

More and More countries are facing water shortage and the condition is graver in the developing and third world countries of Asia, Africa where about 800 million people are living without access to safe drinking water. Potential of drinking water to transmit microbial pathogens to populations, causing diseases is well known in countries at all levels of economic development (Payment, 1997). Waterborne diseases account for an estimated 4.1% of the total DALY global burden of disease and cause 1.8 billion human deaths annually and 88% of that burden is attributable to unsafe water supply, sanitation and hygiene. Access to clean water is not just an issue for developing countries. Despite wealthy economies and access to proven drinking water-treatment technologies, significant outbreaks of waterborne intestinal disease have occurred in North America and Western Europe over the last 10–15 years. From 1970 to 2014, around 293 water borne outbreaks were reported in small non-community drinking water systems in Canada and USA (Pons, 2015).

Contamination of water resources by sewage, animal wastes, human excrement and storm water run-off presents greatest danger to public health associated with drinking water, and bacteriological testing continues to provide the most sensitive means for the detection of such pollution. In cities septic tanks, open dumps, improper constriction latrines and surface impoundments are the most common sources for sewage contamination, so that regular examination of water quality for the presence of pathogenic organisms, chemicals and other physical contents must be conducted to provide information on the level of the safety of water.

Microorganisms are ubiquitous in all terrestrial and aquatic ecosystems. But only a few are human pathogens, capable of causing illness in humans. Contaminated water serves as a good source of these pathogens commonly identified and associated with waterborne diseases. The source of these harmful organisms is usually the feces or other wastes of humans and various warm-blooded animals. Today there are many recognized waterborne pathogens, many of which being able to cause infections even when ingested in extremely small numbers (Skraber et al., 2005). The majority of waterborne outbreaks classified as Acute gastrointestinal illness (AGI) are caused mainly by Salmonella, Shigella, Campylobacter, Giardia, Cryptosporidium and viral agents. In addition, there are a number of newly recognized etiologic agents known to cause waterborne disease, such as enteric waterborne emerging pathogens like caliciviruses, E. coli 0157:H7, Helicobacter sp., Mycobacterium avium complex (MAC) and protozoa Cryptosporidium sp., Cyclospora sp. and Toxoplasma sp. Of recent concern is the emergence of verocytotoxin (Shiga toxin) producing bacteria that contaminates water and food sources (Grotiuz et al., 2006).

The increasing demography and the growing water demand has led to a global deterioration of surface waters quality and in areas facing a water shortage, more and more reclaimed water will be used.